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Wounding Patterns of United States Marines and Sailors During Operation Iraqi Freedom: Major Combat Phase

James Zouris

**Naval Health Research Center
San Diego, California**

**Work sponsored by the Office of Naval Research, Bureau of Medicine and
Surgery, and the Marine Corps Warfighting Laboratory**

Objective

- ❑ Discuss the wounding data from OIF:
Evacuation Routes
ICD-9 Diagnostic Categories
Anatomical Locations
Causative Agent
- ❑ Methodology to generate Patient
Streams in terms of Patient Condition
codes

Methods

- ❑ 279 Navy–Marine Corps casualties were identified as wounded-in-action during the first phase and peak involvement of Marines during OIF (March – May 2003)
- ❑ All casualties who were seen at a level 2 medical treatment facility and who were involved in hostile actions or characterized as WIA were identified for analyses (RTD excluded).

Data were obtained from the Navy–Marine Corps CTR (n=279)

- Shock Trauma Platoons/FRSS
- Surgical companies
- Fleet Hospitals
- Landstuhl Regional Medical Center (LRMC)
- Transportation Command Regulating and Command and Control Evacuation System (TRAC2ES)
- Personnel Casualty Reports

STP/FRSS	A-SURG	B-SURG	C-SURG	FH-3	FH-8	LRMC	LRMC Rec	BETHESDA	PCR	TRAC2ES
83	54	124	48	59	80	147	96	123	252	260
30%	19%	44%	17%	21%	29%	53%	34%	44%	90%	93%

Patient Flow Frequency Matrix

RT	LEVEL 2-	LEVEL 2	LEVEL 2	LEVEL 2	LEVEL 3	LEVEL 3	LEVEL 4	LEVEL 4	CONUS	PATIENTS	Percentage
1	STP/FRSS		B-SURG		47TH			LRMC		11	3.9%
2		A-SURG						LRMC	BETH	10	3.6%
3				C-SURG	47TH			LRMC	BETH	10	3.6%
4			B-SURG		47TH			LRMC		9	3.2%
5			B-SURG		47TH			LRMC	BETH	9	3.2%
6			B-SURG							8	2.9%
7	STP/FRSS		B-SURG		47TH		FH-8			8	2.9%
8			B-SURG		47TH	FH-3		LRMC	BETH	8	2.9%
9		A-SURG						LRMC		6	2.2%
10			B-SURG		47TH		FH-8			6	2.2%
11		A-SURG			47TH			LRMC	BETH	6	2.2%
12	STP/FRSS		B-SURG					LRMC		5	1.8%
13					47TH					5	1.8%
14			B-SURG			FH-3				5	1.8%
15							FH-8			5	1.8%
16	STP/FRSS		B-SURG		47TH			LRMC	BETH	5	1.8%
17					47TH		FH-8		BETH	5	1.8%
18			B-SURG			FH-3	FH-8		BETH	5	1.8%

Represents approximately 50% of all Patients Evacuation Routes

ICD-9 Percentage Distribution - All Diagnoses

ICD-9 DIAGNOSTIC CATEGORIES	<i>N</i>	%
Open wounds (870-897), excludes amputations	259	42.0
Fractures (800-829)	109	17.7
All other ICD-9 codes	64	10.4
Supplemental classifications (V-codes)	28	4.5
Burns (940-949)	22	3.6
Sprains and strains (840-848)	20	3.2
Amputations (885-887) & (895-897)	15	2.4
Contusions (920-924)	15	2.4
Acute posthemorrhagic anemia (285.1)	14	2.3
Infections bacterial infection (041.XX)	12	1.9
Superficial injuries (910-919)	12	1.9
Intracranial injury (850-854)	10	1.6
Hearing loss (389.1)	9	1.5
Nerve injuries (950-957)	9	1.5
Dislocations (830-839)	8	1.3
Blindness, visual disturbances (368-369)	7	1.0
Crushing injury (925-929)	6	0.8
Total diagnoses	617	100.0
Total patients	279	
Average diagnosis per patient	2.2	

Anatomical Location Distribution - All Regions

ANATOMICAL LOCATIONS	
Lower extremities	34.5
Upper extremities	33.9
Face	5.6
Chest	5.0
Back	4.5
Eye	4.5
Head	3.9
Ear	2.7
Neck	1.9
Pelvis	1.9
Abdomen	1.7
Total	100
Total anatomical areas	454
Average per patient	1.6

Causative Agent Distribution

CAUSATIVE AGENT	N	%
Explosive munitions	130	46%
Shrapnel, unspecified	40	14%
RPG	39	14%
IED/Blasts	20	7%
Mortar	20	7%
Land mine	11	4%
Small arms	70	25%
Motor vehicle accidents	26	9%
Falls	18	6%
Weaponry accidents (hostile)	10	4%
Other	14	5%
Not stated	11	4%
Total	279	

Comparison of the Anatomical Locations by Agent

Location	IED/Blast	Land Mine	RPG	Mortar	Shrapnel	Small Arms	All Injuries
Abdomen	0.0%	3.0%	1.2%	3.3%	0.0%	4.9%	1.7%
Back	0.0%	0.0%	2.5%	3.3%	1.7%	1.2%	4.5%
Chest	2.8%	3.0%	3.7%	0.0%	5.2%	8.5%	5.0%
Ear	5.6%	0.0%	9.9%	0.0%	1.7%	0%	2.7%
Eye	8.3%	0.0%	9.9%	3.3%	5.2%	1.2%	4.5%
Face	13.9%	3.0%	2.5%	10.0%	15.5%	4.9%	5.6%
Neck	0.0%	0.0%	2.5%	0.0%	6.9%	1.2%	1.9%
Head	5.6%	0.0%	6.2%	3.3%	5.2%	1.2%	3.9%
Lower extremities	30.6%	78.8%	25.9%	33.3%	29.3%	31.7%	34.5%
Pelvis	2.8%	0.0%	2.5%	6.7%	1.7%	2.4%	1.9%
Upper extremities	30.6%	12.1%	33.3%	36.7%	27.6%	42.7%	33.9%
Total	100%	100%	100%	100%	100%	100%	100%
Patients	20	11	39	20	40	70	279
Anatomical regions	39	33	81	30	58	82	454
Average regions per patient	2.0	3.0	2.1	1.5	1.5	1.1	1.6

ICD-9 Categories	IED/ Blasts	Landmine	RPG	Mortar	Shrapnel	Small Arms
Acute post hemorrhagic anemia (285.1)	3.2%	6.8%	4.0%	0.0%	0.0%	2%
Blindness Visual Disturbances (360-379)	0.0%	0.0%	5.0%	0.0%	2.9%	0%
Hearing Loss (389.1)	1.6%	0.0%	6.0%	1.6%	1.5%	0%
Fractures (800-829)	11.3%	13.6%	12.0%	6.5%	5.9%	17%
Dislocations (830-839)	1.6%	0.0%	0.0%	0.0%	0.0%	0%
Sprains and Strains (840-848)	0.0%	0.0%	2.0%	1.6%	0.0%	1%
Intracranial Injury (850-854)	3.2%	0.0%	2.0%	1.6%	0.0%	1%
Open Wounds (870-897)	53.2%	43.2%	36.0%	37.1%	72.1%	52%
Amputations (885-887) & (895-897)	3.2%	13.6%	6.0%	3.2%	0.0%	0%
Superficial Injuries (910-919)	4.8%	2.3%	3.0%	0.0%	1.5%	0%
Contusions (920-924)	3.2%	0.0%	2.0%	1.6%	4.4%	0%
Crushing Injury (925-929)	0.0%	0.0%	0.0%	0.0%	0.0%	0%
Burns (940-949)	3.2%	0.0%	8.0%	8.1%	0.0%	0%
Nerve injuries (950-957)	0.0%	2.3%	1.0%	0.0%	1.5%	4%
All Other ICD-9 Codes	6.5%	13.6%	4.0%	9.7%	10.3%	11%
Supplemental classifications (V-codes)	4.8%	4.5%	5.0%	0.0%	0.0%	9%
Total	100%	100%	100%	100%	100%	100%
Patients	20	11	39	20	40	70
Total number of ICD-9 codes	62	44	100	44	68	155
Average No. of ICD-9 per patient	3.1	4.0	2.6	2.2	1.7	2.2

2.3%
1.0%
1.5%
17.7%
1.3%
3.2%
1.6%
42.0%
2.4%
1.9%
2.4%
0.8%
3.6%
1.5%
10.4%
4.5%
279
617
2.2

Results and Findings

- THE DISTRIBUTION OF BATTLE INJURIES AND ANATOMICAL LOCATIONS DIFFER BY CAUSATIVE AGENT
- APPROXIMATELY 2 OUT OF 3 BATTLE INJURIES ARE OPEN WOUNDS AND OR FRACTURES
- APPROXIMATELY 3 OUT OF 4 INJURIES ARE TO THE EXTREMITIES
- CASUALTIES ARE SUSTAINING MULTIPLE INJURIES PRIMARILY DUE TO EXPLOSIVE MUNITIONS
 - 2.2 ~ *ICD-9 DIAGNOSES PER PATIENT*
 - 1.6 ~ *AFFECTED ANATOMICAL LOCATIONS*

Approach to update the Planning Factors

- (1) Update the default PC code percentages for the Navy/Marines that are currently incorporated into MAT to reflect the recent injury and illness patterns from OIF
- (2) Update and develop a standardized methodology to determine admission and occurrence rates for Navy and Marine Corps DNBI rates.

MAT provides medical planners worldwide the level and scope of medical support needed for a joint operation, and the capability of evaluating courses of action for probable scenarios.

MAT is part of the TMIP which provides automated solutions for deployed forces during all military operations.

Input WIA / Input NBI / INPUT DIS / PCOE Output1 /

Input WIA / Input NRI / INPUT DIS / PCOE Output 1

Transportation Command (TRANSCOM) Regulating and Command and Control Evacuation System (TRAC2ES) and Personnel Casualty Reports were used to validate and verify information. TRAC2ES provides transportation planners documentation on patient regulation/movement in the theater of operations.

	Air Force	Army	Marine Corps	Navy
OEF-Battle Injury	1.0%	0.6%	1.3%	1.1%
OEF-DNBI	40.2%	8.6%	11.9%	32.1%
OIF-Battle Injury	1.9%	11.3%	29.5%	2.8%
OIF-DNBI	56.9%	79.5%	57.2%	64.1%
	100.0%	100.0%	100.0%	100.0%
N-size*	895	13313	2282	757

***Multiple Patient Movement**

Source TRAC2ES Jan03 – Aug03

METHODS

- **All casualties who were involved in hostile actions or characterized as Battle Injury were identified for analyses**
- **10% of records had conflicting information on type of casualty event whether it was Hostile or Non Hostile**
- **When a patient had conflicting information on the casualty event the incident report was used to make judgment call**
- **Only Primary Diagnosis Information was used for analysis**
- **The last MTF was used as the primary diagnoses if differed from previous MTF (exception V-code)**
- **Three methods of Identifying the casualty were used to determine each unique patient: SSN, NAME, Patient ID**

TRAC2ES

672 Total Patient Movement to Different MTF for 265 Marines = 2.53
1499 Total Patient Movement to Different MTF for 594 Soldiers = 2.52

CHI Square Comparison of Primary ICD-9 Diagnostic Categories by Army and Marines Battle Casualties

	Army (n=594)	Marines (n=266)
Amputations	3.9%	3.8%
Burns	4.9%	3.0%
Crushing	1.7%	1.5%
Dislocation	1.2%	1.9%
E-code	2.5%	1.1%
Fractures	20.2%	21.1%
Intracranial	0.8%	2.3%
Missing	2.2%	1.9%
Musculoskeletal	3.5%	2.6%
Other	3.4%	1.1%
Other Injuries	2.7%	1.5%
Sense-ear	5.9%	2.3%
Sense-eye	2.5%	0.8%
Sprain	3.0%	3.4%
Wound	41.6%	51.9%
Value = 24.39	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14	p=0.041

CHI Square Comparison of Anatomical Location of Primary Open Wound for Army and Marines Battle Casualties

	Army (n=247)	Marines (n=138)
Abdomen	5.7%	2.9%
Buttock	3.2%	3.6%
Eye/Ear	8.1%	2.9%
Face/Neck	8.5%	10.9%
Foot/ankle	5.7%	7.2%
Arm	11.7%	18.1%
Hand/wrist	5.7%	5.1%
Head	2.8%	2.2%
Leg	27.5%	29.7%
Multiple	5.7%	1.4%
Shoulder	3.6%	6.5%
Thorax	11.7%	9.4%
Value = 14.93	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11	p=0.19
N of Valid Cases	385	

CHI Square Comparison of Anatomical Location of Fracture for Army and Marines Battle Casualties

	Army (n=120)	Marines (n=56)
Femur	10.8%	10.7%
Foot/Ankle/Toes	24.2%	12.5%
Hand/Wrist/Fingers	12.5%	19.6%
Humerus	5.8%	3.6%
Mandible	3.3%	7.1%
Other	11.7%	7.1%
Radius	5.8%	8.9%
Spine	4.2%	8.9%
Tibia	21.7%	21.4%
Value = 8.29	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8	p=0.41
N of Valid Cases	176	

PCOF ESTIMATOR

SUMMARY

- THE DISTRIBUTION OF BATTLE INJURIES WERE DEPENDENT OR VARIED FOR MARINES AND ARMY SOLDIERS DURING OIF-1
- THE LOCATION OF OPEN WOUNDS DID NOT VARY FOR MARINES AND SOLDIERS
- THE LOCATION OF FRACTURES DID NOT VARY FOR MARINES AND SOLDIERS

OPEN WOUNDS	MAT	OIF-1	
Abdomen	3.7%	4.7%	
Forearm/upper arm	18.3%	14.0%	
Shrapnel (multiple)	5.1%	4.2%	
Buttocks	3.9%	3.4%	
Eye	2.2%	6.2%	
Face/neck	11.8%	9.4%	
Foot/ankle/toe	5.3%	6.2%	
Genitals	0.5%		
Hand/finger	5.3%	5.5%	
Head	5.6%	2.6%	
Leg	29.8%	28.3%	
Shoulder	2.0%	4.7%	
Thorax	6.5%	10.9%	

FRACTURES	MAT		OIF-1
Clavicle	0.5%		2.3%
Facial excluding mandible	3.8%		2.3%
Femur	12.1%		10.8%
Foot/ankle	11.6%		20.5%
Hand/finger	12.7%		14.8%
Skull	3.1%		2.3%
Humerus	12.4%		5.1%
Mandible	2.5%		4.5%
Knee	1.2%		1.1%
Pelvis	2.0%		1.1%
Radius/ulna	13.3%		6.8%
Rib	2.1%		1.1%
Spine	3.3%		5.7%
Tibia/fibula	19.5%		21.6%